GATES LEARJET CORPORATION

maintenance manual

CHAPTER

8

LEVELING & WEIGHING

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*8-List of Effective Pages	1	Aug 6/82
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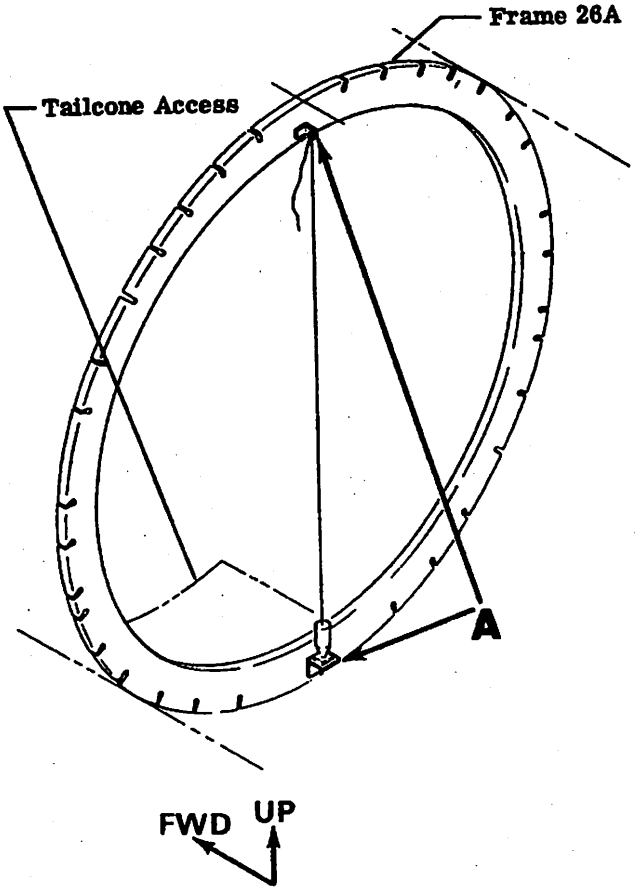
LEVELING - DESCRIPTION AND OPERATION

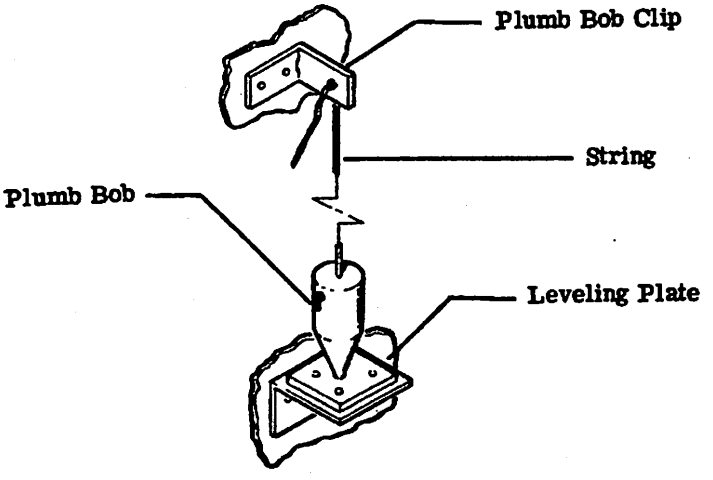
1. General
 A. Aircraft leveling is accomplished by using a plumb bob clip and leveling plate located in the upper and lower tailcone area immediately aft of frame 26A (Sta. 492.55) at BL 0. A string with plumb bob attached is suspended down from the inboard side of the clip so that the plumb bob point extends into the hole of the leveling plate. The aircraft is considered level when the plumb bob extends into, but does not touch the sides of the hole.

2. Tools and Equipment

NAME	PART NUMBER	MANUFACTURER	USE
Plumb Bob		Commercially Available	Level aircraft.
String		Commercially Available	Level aircraft.

3. Leveling
 A. Level the Aircraft (See figure 1)
 (1) Lower tailcone access door.
 (2) Attach plumb bob and string to plumb bob clip located on the aft side of frame 26A.
 (3) Place aircraft on jacks. (Refer to 7-00-00)
 (4) Adjust jacks until plumb bob point extends into leveling plate hole without touching sides of hole.





Detail A

Aircraft Leveling
Figure 1

WEIGHING - DESCRIPTION AND OPERATION

1. General

A. From time to time it will become necessary to weigh and re-establish the aircraft basic weight and moment. Unless platform scales are available, the aircraft is weighed electronically by means of load cells attached to the jacks. The following procedure is applicable when using Cox and Stevens Electronic Scales.

2. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Electronic Scales	C-41150-1	Cox & Stevens Electronics Scales Division, Wallingford, Conn.	Weighing aircraft

3. Weighing

A. Weigh the Aircraft (See figures 1 thru 3)

NOTE: All weighing operations must be conducted in a closed hangar and care taken that no air currents pass over the aircraft during weighing.

(1) Place the weighing kit close enough to the aircraft so that the 50 foot load cell cables will reach the three jack points and the 25 foot power cable will reach the 115 volt outlet (if 115 volts is to be used).

(2) Unreel load cell cables and, observing color coding, connect the load cells to the cables.

NOTE: The load cells and their cables are color coded and must always be connected red to red, blue to blue and yellow to yellow.

(3) Set CELL BALANCE switch on the indicator-amplifier to OFF.

(4) Set toggle switch on power supply box to either 115 VAC, 60 Hz., or 24 VDC BATT depending on power source to be used.

(a) When using 115 volts AC, connect one end of the 25 foot power cable to the plug in the tip of the power supply box marked AC LINE and the other end to the power source. Set the BATTERY VOLTAGE switch on the indicator-amplifier ON. Turn the AC VOLTAGE ADJUSTMENT knob until the Balance Meter pointer rests in the center of the green area.

(b) When using 24 volts DC, connect one end of the 15 foot power cable to the connector (male) which exits out the right hand side of the indicator-amplifier and the other end (battery clips) to the power source. Set BATTERY VOLTAGE switch on the indicator-amplifier to ON. If the Balance Meter pointer swings into the yellow section, the polarity is reversed and the battery clips must be switched. If the Balance Meter pointer rests in either red section of the scale, the battery voltage is either too high or too low as indicated on the scale. Replace battery and/or adjust voltage until Balance Meter pointer rests in the center of the green section on the scale.

(5) Select proper cell-to-jack adapters in accordance with the placard on the lid of the weighing kit case and attach adapters to load cells.

NOTE: Assure that the cell-to-jack adapters are threaded fully into the load cells and that the proper adapters are used; otherwise, damage to the aircraft, cell damange or inaccurate weight readings may occur.

(6) With power on, allow the equipment to warm up a minimum of 20 minutes; this can be concurrent with aircraft preparation. A partial load on the cells is recommended during warm-up period.

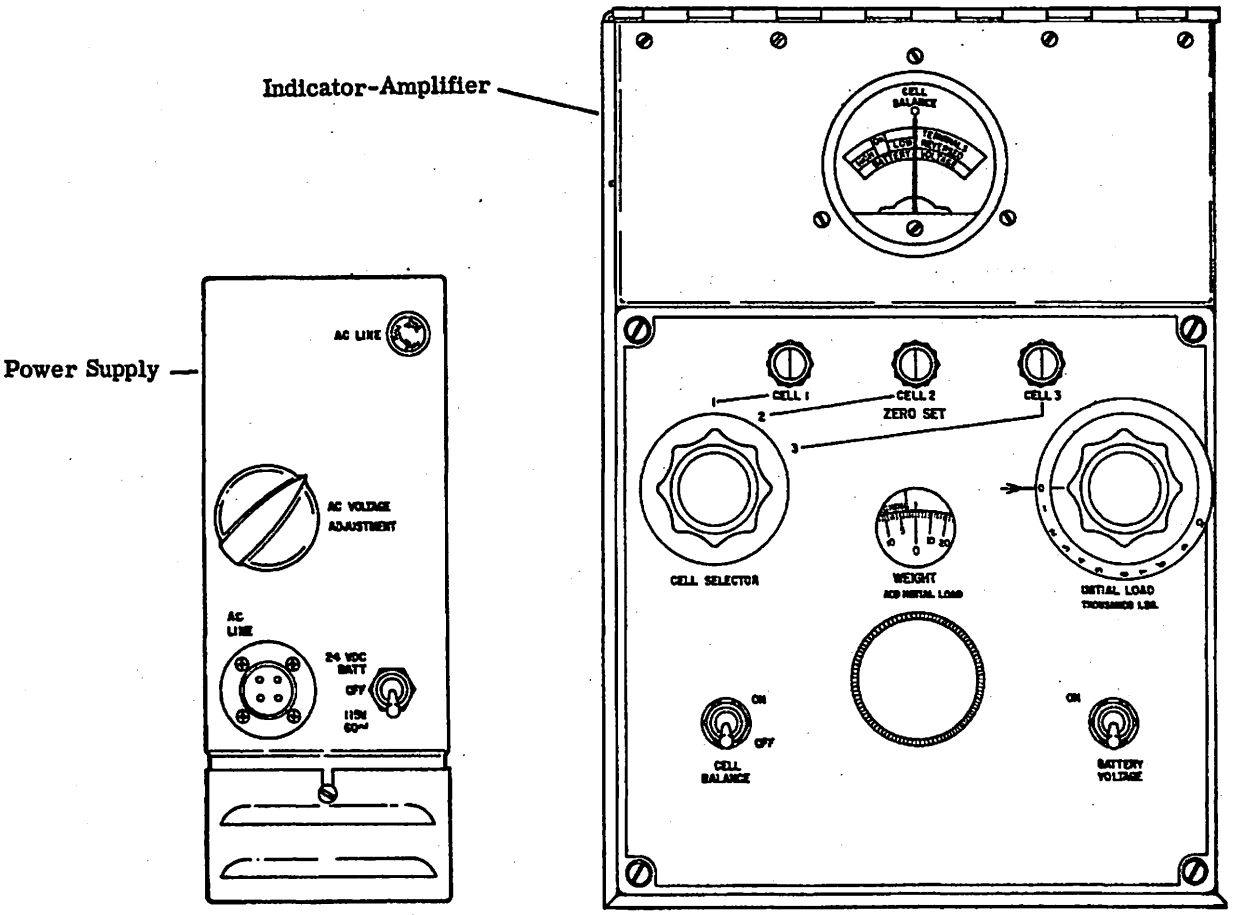
(7) Remove all loose equipment from the aircraft which is not a part of the aircraft empty weight.

(8) Inventory the aircraft for items which are not part of the empty weight but will have to be weighed with the aircraft. Enter each item, its weight and its arm under Column I in the Aircraft Weighing Record. The jack pads and attaching bolts are not part of the aircraft empty weight and must be entered under Column I in the Aircraft Weighing Record.

(9) Inventory the aircraft for items which are fixed equipment but will not be weighed with the aircraft. For example, a seat which has been removed for repair. Enter each item, its weight and its arm under Column II of the Aircraft Weighing Record.

(10) Defuel the aircraft. (Refer to 12-00-00)

NOTE: The basic weight of the aircraft includes trapped and unusable fuel. If the fuel system has been purged, the trapped and unusable fuel weight and moment must be entered under Column II in the Aircraft Weighing Record. Model 25B/D fuel weight is 156.2 pounds (based on 6.7 pounds per gallon) and fuel moment is 58,100. Model 25C/F fuel weight is 156.0 pounds (based on 6.7 pounds per gallon) and fuel moment is 58,900.



Aircraft Electronic Weighing Kit
Figure 1

(11) If necessary, wash aircraft to remove any accumulation of mud, dirt or grease.
(12) Service the following to normal operating capacity: oil tanks, hydraulic reservoir, hydraulic accumulator, refrigeration system, oxygen bottle, emergency air bottle, nose gear strut and main gear struts. Refer to 12-00-00 for servicing procedures.
(13) Lower tailcone access door and attach leveling plumb bob. (Refer to 8-10-00)
(14) Attach jack pads to nose and wings. (Refer to 7-10-00)
(15) Attach load cells to jacks (see figure 2) assuring the adapters are properly secured.

NOTE: When ring type cell-to-jack adapters are used, assure that it is centered flush on the jack ram and apply a downward pressure before tightening setscrews.

(16) Position jacks, with cells attached, under, but not touching, jack pads.
(17) Set CELL BALANCE switch on the indicator-amplifier to ON. There must not be any load on the cells at this time.
(18) Set WEIGHT dial and INITIAL LOAD selector to 0.
(19) Set the CELL SELECTOR to 1. Turn ZERO SET knob, marked CELL 1, until Balance Meter Pointer is on 0. Repeat this procedure for CELL 2 and CELL 3. Once the circuits have been zeroed, the ZERO SET knobs should not be changed.

CAUTION: KEEP THE AIRCRAFT LEVEL WHILE JACKING. EXCESSIVE SIDE LOADS MAY CAUSE CELL DAMAGE, DAMAGE TO THE AIRCRAFT OR INCORRECT WEIGHT READINGS.

USE PROPER ADAPTERS ON JACKS TO PREVENT SLIPPING OR BUCKLING.

NEVER APPLY A LOAD ON THE RIM OF THE CELLS.

(20) Jack the aircraft until it is clear of the floor.
(21) Level the aircraft. (Refer to 8-10-00)
(22) Remove plumb bob and secure tailcone access door.
(23) Close aircraft cabin door.
(24) Drain tip tank, wing and fuselage sumps.

(25) Set CELL SELECTOR to 1. The Balance Meter pointer will swing to the right. Turn the INITIAL LOAD selector until the Balance Meter pointer swings to the left. Set INITIAL LOAD selector to next lower calibration. Adjust WEIGHT dial until Balance Meter pointer rests on 0. The combined reading of the INITIAL LOAD selector and WEIGHT dial is the weight on that cell. Record the weight in the proper space marked Scale Reading in the Aircraft Weighing Record. Repeat for CELL 2 and CELL 3. A minimum of two weight readings should be taken on each cell, upsetting the cell balance each time.

(26) Lower the jacks until all load is removed from the cells.

(27) Set INITIAL LOAD selector to 0. Adjust the WEIGHT dial until the Balance Meter pointer is on 0. If there is a plus reading on the WEIGHT dial, divide it by two and enter it as a negative number under Tare on the Aircraft Weighing Record. If there is a minus reading on the WEIGHT dial, enter it as a positive number under Tare on the Aircraft Weighing Record. Repeat for the other two cells. If the tare is greater than 25 pounds the weighing procedure must be repeated.

(28) Turn off all switches, disconnect power and cell cables and return all components to the kit case. Set WEIGHT dial to read minus 50 pounds.

(29) Add or subtract the tare of each cell to or from its respective scale reading; enter the result under Net Weight in the Aircraft Weighing Record.

(30) Subtotal the left and right jack net weights.

(31) Multiply the net weight of the left and right jacks combined by their arm (414.85) to obtain moment. Record under Moment in the Aircraft Weighing Record.

(32) Multiply the net weight of the nose jack by its arm (183.78) to obtain moment. Record under Moment in the Aircraft Weighing Record.

(33) Add the two moments.

(34) Add the net weights.

(35) Divide total moment by total weight to obtain CG of the aircraft as weighed.

(36) Total Column I weights and subract from aircraft total weight.

(37) Total Column I moments and subtract from aircraft total moment.

(38) Total Column II weights and add to aircraft total weight. This is the aircraft basic weight.

(39) Total Column II moments and add to aircraft total moment. This is the aircraft basic moment.

(40) Divide basic moment by basic weight. This is the CG of the aircraft.

4. Determining Aircraft CG in Percent of MAC

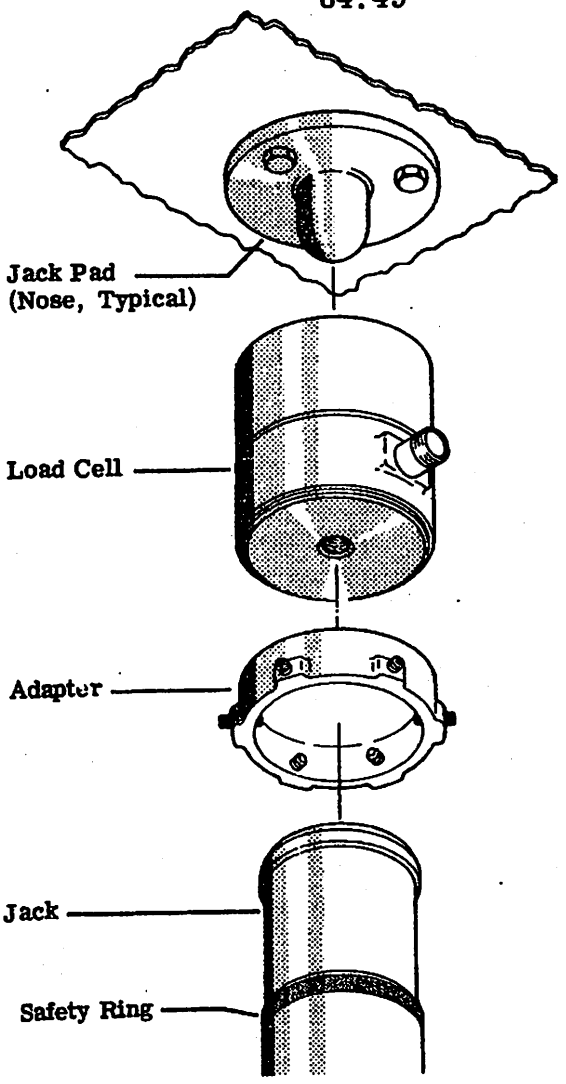
A. From the following formula it can be determined whether the aircraft CG is within the prescribed limits as defined by the Weight and Balance Data Manual. The formula states:

$$\% \text{ of MAC} = \frac{\text{Fuselage Station - Leading Edge of MAC}}{\text{MAC}}$$

Where:
(1) Fuselage station is the CG or arm as defined in the Weight and Balance Data Manual
(2) Leading edge of MAC is 360.02
(3) MAC is 84.49

Therefore:

$$\% \text{ of MAC} = \frac{\text{Fuselage Station - 360.02}}{84.49}$$



Attaching Weighing Cell to Aircraft Jack
Figure 2

AIRCRAFT WEIGHING RECORD

Date Weighed	Model 25B/C/D/F	Serial No.
Place Weighed	Weighing Personnel:	

Reaction	Scale Reading	Tare	Net Weight	Arm	Moment
Left Jack					
Right Jack					
Sub Total				414.85	
Nose Jack				183.78	
Total (as weighed)					
Total Items Column I			−		
Total Items Column II			+		
Basic Airplane					

COLUMN I				COLUMN II			
Items weighed but not part of basic Airplane	Weight	Arm	Moment	Basic Items not in when weighed	Weight	Arm	Moment
TOTAL				TOTAL			

Aircraft Weighing Record
Figure 3

WEIGHING - MAINTENANCE PRACTICES

1. Weighing

A. Tools and Equipment

NAME	PART NUMBER	MANUFACTURER	USE
Electronic Scales	C-55800-3-10 or equivalent	Revere Corp. of America Wallingford, Conn.	Weighing aircraft

B. Weigh the aircraft (electronic scales) (See figure 201)

(1) Refer to the electronic kit operating manual for specific weighing instructions.

NOTE: ● All weighing operations must be conducted in a closed hangar and care taken that no air currents pass over the aircraft during weighing, or inaccurate readings will result.

● The basic weight of the aircraft includes trapped and unusable fuel. If the fuel system is drained (dry aircraft), the trapped and unusable fuel weight and moment must be entered under Table II in the Aircraft Weighing Record. Refer to Approved Airplane Flight Manual, Weight and Balance Section, for unusable fuel weights.

(2) Record the weight on each scale cell in the proper space marked Scale Reading in the Aircraft Weighing Record-Electronic Scale.

(3) With all weight removed from the cells and scale switches adjusted to zero, a small plus or minus weight reading may occur on the scale. If there is a plus reading, divide it by two and enter it as a negative number under Tare on the Aircraft Weighing Record. If there is a minus reading, divide it by two and enter it as a positive number under Tare on the Aircraft Weighing Record. If the tare is greater than ±5 pounds (±2.27 kg) for any one cell, repeat the weighing procedure.

(4) Add or subtract the tare of each cell to or from its respective scale reading. Enter the result under Net Weight in the Aircraft Weighing Record.

(5) Subtotal the left and right jack net weights.

(6) Multiply the net weight on the left and right jacks combined by their arm (414.85) to obtain moment. Record under Moment in the Aircraft Weighing Record.

(7) Multiply the net weight on the nose jack by its arm (183.78) to obtain moment. Record under Moment in the Aircraft Weighing Record.

(8) Add the two moments.

(9) Add the net weights.
(10) Divide total moment by total weight to obtain CG of the aircraft as weighed.
(11) Total Table I weights and subtract from aircraft total weight.
(12) Total Table I moments and subtract from aircraft total moment.
(13) Total Table II weights and add to aircraft total weight. This is the aircraft basic weight.
(14) Total Table II moments and add to aircraft total moment. This is the aircraft basic moment.
(15) Divide basic moment by basic weight. This is the CG of the aircraft.

C. Weigh the Aircraft (Platform Scales) (See figure 201)

NOTE: All weighing operations must be conducted in a closed hangar and care taken that no air currents pass over the aircraft during weighing.

(1) Remove all loose equipment from the aircraft which is not a part of the aircraft empty weight.
(2) If necessary, wash aircraft to remove any accumulation of mud, dirt or grease.
(3) Defuel the aircraft. Refer to Chapter 12.

NOTE: The basic weight of the aircraft includes trapped and unusable fuel. If the fuel system has been drained (dry aircraft), the trapped and unusable fuel weight and moment must be entered under Table II in the Aircraft Weighing Record. Refer to Approved Airplane Flight Manual, Weight and Balance Section, for unusable fuel weights.

(4) Service the following to normal operating capacity; oil tanks, hydraulic accumulator, refrigeration system, oxygen bottle, and emergency air bottles. Refer to Chapter 12 for servicing procedures.
(5) Inventory the aircraft for items which are part of the empty weight but will have to be weighed with the aircraft. Enter each item, its weight, and its arm under Table I in the Aircraft Weighing Record (figure 201).

NOTE: If the platform scales are not equipped with built-in chocks, the wheel chocks used after the aircraft is placed on the scales will need to be weighed and entered per step (5).

(6) Inventory the aircraft for items which are fixed equipment but will not be weighed with the aircraft; for example, a seat which has been removed for repair. Enter each item, its weight and its arm under Table II of the Aircraft Weighing Record (figure 201).
(7) Inflate tires to proper pressure. Refer to Chapter 12.

(8) Deflate the landing gear shock struts.
(9) Jack the aircraft (refer to Chapter 7) until the wheels are off the floor far enough to place the platform scales under the wheels.
(10) Position the platform scales under the wheels and lower the aircraft onto the scales. Install wheel chocks and remove jacks and jack pads from the aircraft.
(11) Lower tailcone access door and attach a plumb bob and string to the plumb bob clip located on the aft side of frame 26A.
(12) Inflate the main gear struts until the aircraft is level (the plumb bob point extends into the leveling plate hole without touching the sides of the hole).
(13) Remove plumb bob and secure tailcone access door.
(14) Close passenger/crew door.
(15) Drain wing and fuselage sumps.
(16) The nose wheel axle centerline fuselage station is 167.13 which is entered as the nose jack reaction point under "Arm" in the Aircraft Weighing Record.
(17) Measure the perpendicular distance from the centerline of the nose wheel axle to a line joining the centerlines of the main wheels. Add this measurement to the nose wheel reaction point. Enter this figure (main wheel reaction point) under "Subtotal Arm" in the Aircraft Weighing Record.
(18) Read the weight from each platform scale and enter in the "Scale Reading" column of the Aircraft Weighing Record.
(19) Install jack pads and jacks.
(20) Jack the aircraft until it is completely off of the scales and remove wheel chocks from the scales. If there is a plus reading on the scales, divide it by two and enter it as a negative number under Tare on the Aircraft Weighing Record. If there is a negative reading on the scales, enter it as a positive number under Tare on the Aircraft Weighing Record. If the tare is greater than ±5 pounds (±2.27 kg) for any one scale, the scales need to be recalibrated and certified and the weighing procedure repeated.
(21) Remove the platform scales and lower the aircraft to the ground.
(22) Inflate nose gear shock strut and main gear shock struts. Refer to Chapter 12.
(23) Add or subtract the tare of each scale to or from its respective scale reading; enter the results under Net Weight in the Aircraft Weighing Record.
(24) Subtotal the left and right wheel scale net weights.
(25) Multiply the net weight of the left and right scales combined by their arm (397.00) to obtain moment. Record under "Subtotal Moment" in the Aircraft Weighing Record.

(26) Multiply the net weight on the nose wheel scale by its arm (167.13) to obtain moment. Record under Moment in the Aircraft Weight Record.
(27) Add the two moments.
(28) Add the net weights.
(29) Divide total moment by total weight to obtain CG of the aircraft as weighed.
(30) Total Table I weights and subtract from aircraft total weight.
(31) Total Table I moments and subtract from aircraft total moment.
(32) Total Table II weights and add to aircraft total weight. This is the aircraft basic weight.
(33) Total Table II moments and add to aircraft total moment. This is the aircraft basic moment.
(34) Divide basic moment by basic weight. This is the CG of the aircraft.

2. Determining Aircraft CG in Percent of MAC

A. From the following formula it can be determined whether the aircraft CG is within the prescribed limits as defined by the Weight and Balance Data Manual. The formula states:

$$\text{CG in \% of MAC} = \frac{\text{Fuselage Station - Leading Edge of MAC}}{\text{MAC}} \times 100$$

Where: (1) Fuselage station is the CG or arm as defined in the Weight and Balance Data Manual located in the Approved Airplane Flight Manual.
(2) Leading edge of MAC is 360.02.
(3) MAC is 84.49.

Therefore:

$$\text{CG in \% of MAC} = \frac{\text{Fuselage Station - 360.02}}{84.49} \times 100$$

Date Weighed	Model 25B/C/D/F	Serial No.
Place Weighed	Weighing Inspector:	

Reaction	Scale Reading	Tare	Net Weight	Arm	Moment
Left Jack					
Right Jack					
Sub Total				414.85	
Nose Jack				183.78	
Total (As Weighed)					
Total Items Table I			−		
Total Items Table II			+		
Basic Airplane					

TABLE I

Items weighed but not part of basic airplane	Weight	Arm	Moment
jack pads			
TOTAL			

TABLE II

Basic items not in when weighed	Weight	Arm	Moment
unusable fuel			
TOTAL			

Aircraft Weighing Record - Electronic Scales
Figure 201 (Sheet 1 of 2)

Date Weighed	Model 25B/C/D/F	Serial No.
Place Weighed	Weighing Inspector:	

Reaction	Scale Reading	Tare	Net Weight	Arm	Moment
Left Jack					
Right Jack					
Sub Total					
Nose Jack				167.13	
Total (As Weighed)					
Total Items Table I			—		
Total Items Table II			+		
Basic Airplane					

TABLE I

Items weighed but not part of basic airplane	Weight	Arm	Moment
jack pads			
TOTAL			

TABLE II

Basic items not in when weighed	Weight	Arm	Moment
unusable fuel			
TOTAL			

Aircraft Weighing Record - Platform Scales
Figure 201 (Sheet 2 of 2)